

CLAIMS

1. A method of two-stage stretch forming of a preheated sheet metal blank into a first stage preform shape and then a second stage finish shape part, said blank having a first side and a second side, said method comprising

stretching said blank to said preform shape by pushing said second side against a preform surface on a preform tool, said preform tool being internally heated to maintain said preform surface at a preform temperature for stretching said blank to said preform shape; and immediately thereafter

stretching the preform shape blank to a finish shape part by pushing said first side against a finish form surface on a finish form tool, said finish form tool being internally heated to maintain said finish form surface at a finish form temperature for said preform shape blank, said finish form temperature being lower than said preform temperature.

2. The method of stretch forming a sheet metal blank as recited in claim 1 comprising maintaining said preform surface at a preform temperature for stretching said blank to said preform shape at a higher strain rate than the strain rate for stretching said preform shape blank to said finish shape part.

3. The method of stretch forming a sheet metal blank as recited in claim 1 in which said finish form surface is maintained at a finish form temperature for removal of said finish shape part from said finish form surface.

4. The method as recited in claim 1 in which said stretching steps are accomplished by applying a pressurized working gas against said first

side of said blank to obtain said preform shape and then applying a pressurized working gas against the second side of said blank to obtain said finish shape part.

5. The method as recited in claim 1 in which said sheet metal blank comprises a stretch formable alloy of a metal selected from the group consisting of aluminum, iron, magnesium and titanium.

6. A method of two-stage stretch forming of a sheet metal blank into a first stage preform shape and then into a second stage finish shape part, said blank having a first side and a second side, said method comprising

heating said blank to a preforming temperature for stretch elongation of said sheet under the pressure of a working gas;

placing said heated blank between opposing stretch forming tools comprising a preform tool with a concave preform surface and a finish form tool with a convex finish form surface;

applying a pressurized working gas against the first side of said blank to stretch the second side of the blank against said preform surface to obtain a preform shape blank, said preform tool being internally heated to maintain said preform surface at a preform temperature for stretch elongation of said blank;

releasing said working gas from the first side of said blank;

applying a pressurized working gas against the second side of said blank to push the second side from said preform surface and to stretch the preform shape blank against said finish form surface, said finish form tool being internally heated to maintain said finish form surface at a finish form temperature for said preform shape blank, said finish form temperature being lower than said preform temperature;

releasing said working gas from the second side of said blank;
and
removing the finish shape part from said finish form surface.

7. The method of stretch forming a sheet metal blank as recited in claim 6 comprising maintaining said preform surface at a preform temperature for stretching said blank to said preform shape at a higher strain rate than the strain rate for stretching said preform shape blank to said finish shape part.

8. The method of stretch forming a sheet metal blank as recited in claim 6 in which said finish form surface is maintained at a finish form temperature for removal of said finish shape part from said finish form surface.

9. The method of stretch forming a sheet metal blank as recited in claim 6 comprising maintaining said preform surface at a preform temperature for stretching said blank to said preform shape at a lower pressure of working than the working gas pressure for stretching said preform shape blank to said finish shape part.

10. The method of stretch forming a sheet metal blank as recited in claim 6 comprising maintaining said preform surface at a preform temperature for (a) stretching said blank to said preform shape at a higher strain rate than the strain rate for stretching said preform shape blank to said finish shape part or (b) stretching said blank to said preform shape at a lower pressure of working than the working gas pressure for stretching said preform shape blank to said finish shape part, and said finish form surface is maintained at a finish form temperature for removal of said finish shape part from said finish form surface.

11. The method as recited in claim 6 in which said sheet metal blank comprises a stretch formable alloy of a metal selected from the group consisting of aluminum, iron, magnesium and titanium.

12. The method as recited in claim 6 in which said sheet metal blank is formed of a fine grain, magnesium containing aluminum alloy

13. The method as recited in claim 10 in which said preform temperature for said preform surface is in the range of about 475°C to about 540°C and said finish form temperature for said finish form surface is in the range of about 400°C to about 460°C.

14. The method as recited in claim 11 in which said blank is preheated to a temperature in the range of about 475°C to about 540°C.

15. A method of two-stage stretch forming of a sheet metal blank of a fine grain, magnesium containing aluminum alloy into a first stage preform shape and then into a second stage finish shape part, said blank having a first side and a second side, said method comprising

heating said blank to a preforming temperature in the range of about 475°C to about 540°C;

placing said heated blank between opposing stretch forming tools comprising a preform tool with a concave preform surface and a finish form tool with a convex finish form surface;

applying a pressurized working gas against the first side of said blank to stretch the second side of the blank against said preform surface to obtain a preform shape blank, said preform tool being internally heated to maintain said preform surface at a preform temperature in the range of about 475°C to about 540°C;

releasing said working gas from the first side of said blank;

applying a pressurized working gas against the second side of said blank to push the second side from said preform surface and to stretch the preform shape blank against said finish form surface, said finish form tool being internally heated to maintain said finish form surface at a finish form temperature in the range of about 400°C to about 460°C;

releasing said working gas from the second side of said blank;

and

removing the finish shape part from said finish form surface.